PATENT SPECIFICATION

(11) 1 406 769

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(19)

(54) PNEUMATIC BURROWING APPARATUS

(71) I, PAUL SCHMIDT, a German citizen, of 5945 Saalhausen, Winterbergerstrasse 70, Germany, trading as TRACTO-TECHNIK PAUL SCHMIDT, a German firm of 5940 Lennestadt/Saalhausen, Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a self-propelled pneumatically-operated, burrowing apparatus for driving or enlarging holes or channels in earth, of the kind comprising a tubular housing; a percussion piston which is reciprocable in the housing; and a striker tip arranged to slide in an axial direction relative to the housing and to which kinetic energy can be imparted by the percussion piston in a working direction axial of the housing; in which apparatus the striker tip on impact by the percussion piston thrusts the housing forward in the working direction by acting against adjustably prestressed resilient means contained in the housing, and in which the travel of the striker tip relative to the housing is limited by front and back stops; in accordance with Claim 1 of my British Patent Specification No. 1,392,868.

Due to its special striker tip arrangement, the burrowing apparatus of the abovementioned kind requires a smaller impact energy, compared with conventional burrowing apparatus, for equal thrust power. Hence, the associated percussion piston can have a correspondingly smaller piston area and hence, besides the economy in driving power, a considerable reduction in the diameter of the housing is possible. Furthermore, due to the special arrangement of the striker tip, the housing experiences a very much smaller loading than the housing of a comparable conventional burrowing apparatus.

An object of the present invention is to improve further the burrowing apparatus of the above-mentioned patent specification by providing additional features.

Such features are provided, in accordance with the present invention, by the attachment of a cable grip and/or an expander-cone to the rear end of the tubular housing.

The cable grip consists preferably of a steel wire braid which is plaited diagonally to its longitudinal direction so that the cable grip expands transversely under axial compression and contracts under axial tension. In the transversely-expanded condition of the cable grip, a tube or cable which is to be laid by the burrowing apparatus is pushed into the cable grip. By pulling on the cable grip and the tube or cable, and thereby transversely contracting the cable grip, the tube or cable is firmly connected to the burrowing apparatus, irrespective of the diameter of the tube or cable and the ratio of this to the diameter of the housing of the burrowing apparatus, within a wide range of diameters. The cable grip thereby forms a coupling by which the tube or cable can be coupled to the burrowing apparatus. Furthermore, the use of a cable grip avoids the need for special preparation of the tube or cable to be laid, such as the cutting of a thread in it, for attachment to the burrowing apparatus.

The cable grip itself can be provided, at the end adjacent the housing, with a threaded collar by which it is screwed on to a corresponding external thread on the housing.

To facilitate the laying operation, it is advantageous if the burrowing apparatus has an expander-cone at its rear end which expands the bore in the earth sufficiently for the tube or cable being laid to move in the bore in the earth without any substantial friction.

As another feature of the present burrowing apparatus, straying of the apparatus away from the required path during advancing in the earth may be substantially

obviated by a steering tube attached to the rear end of the housing of the burrowing apparatus. The steering tube ensures that the burrowing apparatus itself, when penetrating voids or wet ground, or when butting against rocks, maintains substantially its required path. In particular, a direction-stabilising straight tube which, in effect, elongates the housing of the burrowing apparatus, serves this purpose for steering a straight path. Alternatively, a curved tube may be used to steer even a straight housing of a burrowing apparatus along a curved path. In the latter case the steering tube preferably also has guide surfaces such as, for example, steering-wings.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figs. 1 and 2 are side views of part of a burrowing apparatus with a cable grip attached thereto, the cable grip being shown in its transversely expanded and contracted states, respectively, in those figures,

Fig. 3 is a side elevation of a burrowing apparatus with an expander-cone arranged at the rear end of the housing of the apparatus,

Fig. 4 is an enlarged side elevation of an alternative expander-cone,

Fig. 5 is a side elevation of a burrowing apparatus with a straight steering tube,

Fig. 6 is a side elevation of the steering tube of Fig. 5, on an enlarged scale, and

Figs. 7 and 8 are a side elevation and plan, respectively, of a burrowing apparatus with a curved steering tube.

Referring to Figs. 1 and 2 of the drawings, a burrowing apparatus 1 is provided with a stub and an external thread at the rear end of its housing. On the external thread is seated a threaded collar 3 to which is attached a cable grip 2. The threaded collar 3 has holes uniformly distributed round its circumference for receiving a C-spanner. The cable grip 2 consists of a steel wire braid which is plaited diagonally to its longitudinal direction so that under longitudinal compression it expands transversely in the manner shown in Fig. 1 and under longitudinal tension it contracts as shown in Fig. 2. When the cable grip is in the transversely expanded state, a tube or cable 4 to be laid by the burrowing apparatus is pushed into the cable grip and on to the stub on the housing. The cable grip is next elongated so that it lies in contact with the tube 4. Then by pulling the cable grip 2 and the tube 4 longitudinally in directions tending to separate them, the cable grip 2 closes firmly round the tube 4 and couples the tube 4 to the burrowing apparatus. During the advancing of the burrowing apparatus in the ground, the cable grip 2 thus takes the tube 4 with it. The cable grip 2 can alternatively be employed on a housing without a stub. Since the tube 4 does not then have to fit over a stub, the cable grip can accommodate tubes (or cables) within a range of different diameters.

Referring to Figs. 3 and 4 of the drawings, the advancing of the burrowing apparatus is, if desired, facilitated by an expander-cone 5 arranged at the rear end of the housing. The expander-cone 5 is either screwed into the rear end of the housing by an appropriate threaded stub as in Fig. 3, or is screwed on to an external thread on the rear end of the housing by a threaded collar 6 as in Fig. 4. Furthermore, the expander-cone 5 has at its rear end a threaded connection for a tube which is to be laid, and/or for a cable grip. The rear end of the expander-cone has a larger diameter than the striker tip 7 and the housing, so that during the advancing of the burrowing apparatus, the expander-cone enlarges the bore in the ground produced by the striker tip 7 and the housing. The friction between the wall of the bore and the tube and/or cable grip following the expander-cone is thereby considerably reduced.

A straight steering tube 8 can, as shown in Figs. 5 and 6, be screwed to the housing of the burrowing apparatus. The steering tube 8 elongates the guiding length of the burrowing apparatus in the ground and thereby acts to stabilise the direction of burrowing of the apparatus. In order that it can be screwed on, the steering tube 8 is provided at its front end with a threaded stub. At the rear end it has a threaded part for connecting an expander-cone and/or a tube which is to be laid or a cable grip.

The steering tube can, however, act not only to stabilise the direction but also to change the direction of the bore. For changing the direction of the bore, a steering tube 9, as shown in Figs. 7 and 8, is curved and if desired may, at the same time, be provided with steering wings 10 which are curved in like manner. If a curved steering tube 9 with steering wings 10 is fitted on to the rear end of the housing of the burrowing apparatus 1, the bore formed in the earth by the apparatus runs in an arc which is dependent upon the curvature of the steering tube 9 and the steering wings 10.

WHAT I CLAIM IS:—

1. A self-propelled pneumatically-operated burrowing apparatus for driving or enlarging holes or channels in earth, the apparatus comprising a tubular housing; a percussion piston which is reciprocable in the housing; a striker tip arranged to slide in an axial direction relative to the housing and to which kinetic energy can be imparted by the percussion piston in a working direction

axial of the housing; and a cable grip and/or an expander-cone attached to the rear end of the housing; in which apparatus the striker tip on impact by the percussion piston thrusts the housing forward in the working direction by acting against adjustably pre-stressed resilient means contained in the housing, and in which the travel of the striker tip relative to the housing is limited by front and back stops.

2. Apparatus as claimed in Claim 1, in which the cable grip comprises a steel wire braid plaited diagonally to the longitudinal direction of the cable grip.

3. Apparatus as claimed in Claim 1 or 2, in which the cable grip has a threaded connector collar for connection to the housing.

4. Apparatus as claimed in Claim 1, Claim 2 or Claim 3, in which the cable grip or expander-cone is attached to the rear end of the housing by way of a steering member.

5. Apparatus as claimed in Claim 4, in which the steering member comprises a straight tube.

6. Apparatus as claimed in claim 4, in which the steering member comprises a curved tube provided with guide surfaces.

7. Apparatus as claimed in Claim 6, in which the guide surfaces comprise steering wings.

8. Apparatus as claimed in Claim 1 and substantially as hereinbefore described with reference to Figs. 1 and 2 or Figs. 3 and 4 of the accompanying drawings.

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Sheet 1

FIG. 1

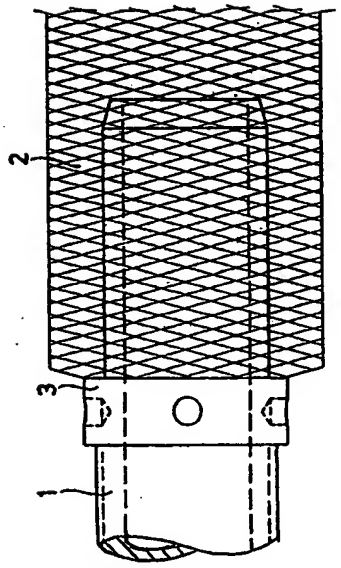
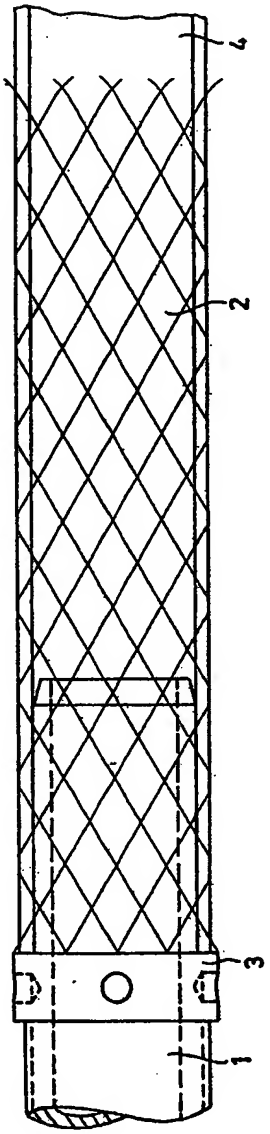


FIG. 2



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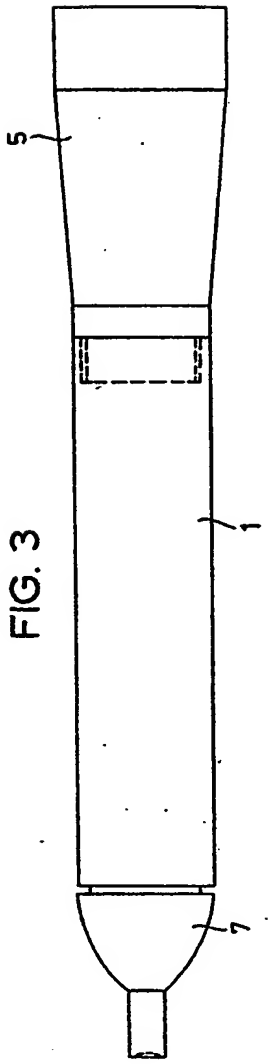

FIG. 3

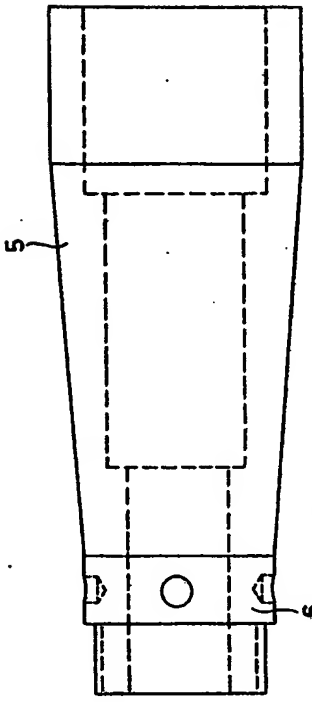

FIG. 4

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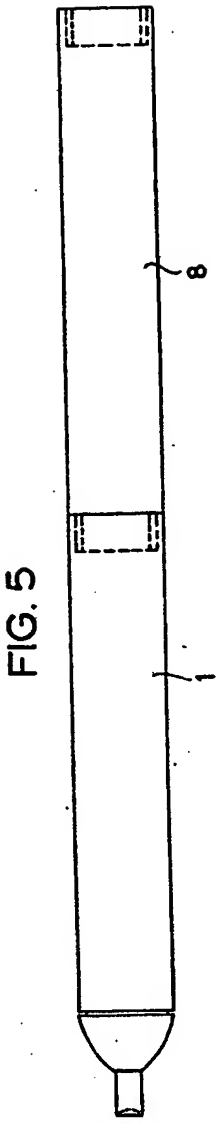

FIG. 5

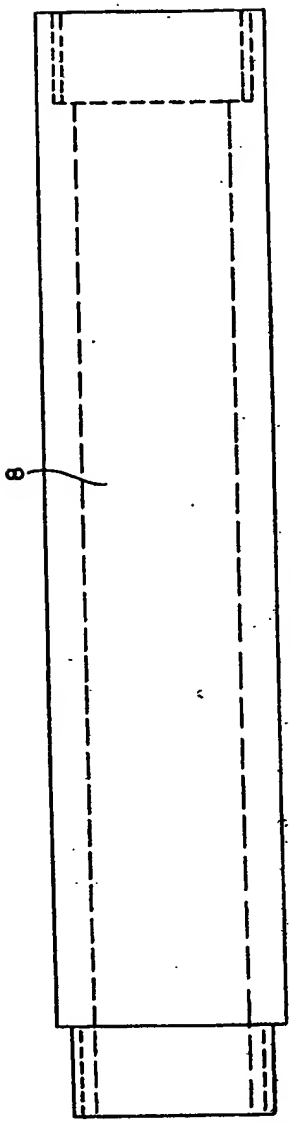

FIG. 6

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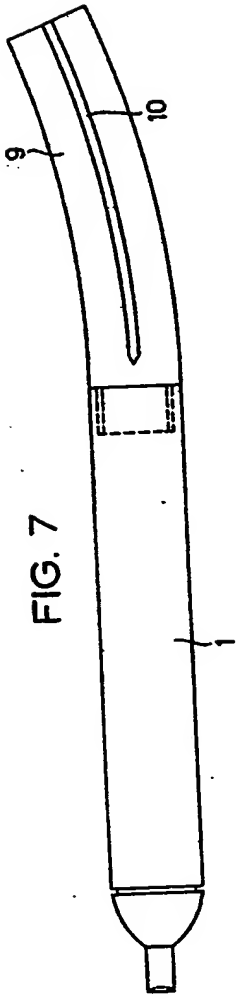

FIG. 7

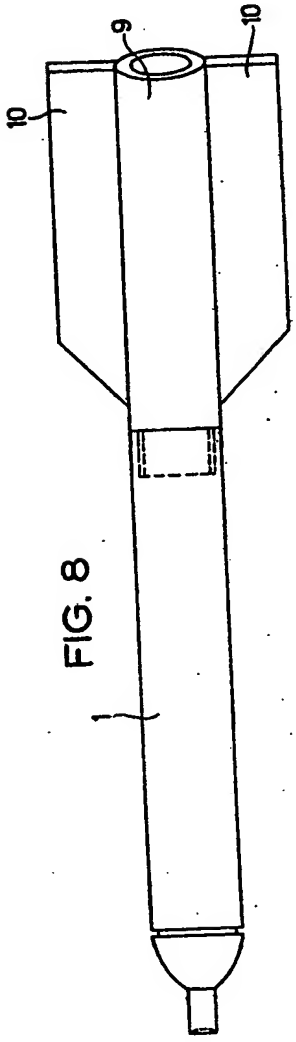

FIG. 8